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THE MIAMI CONSERVANCY BULLETIN

MARCH 1920

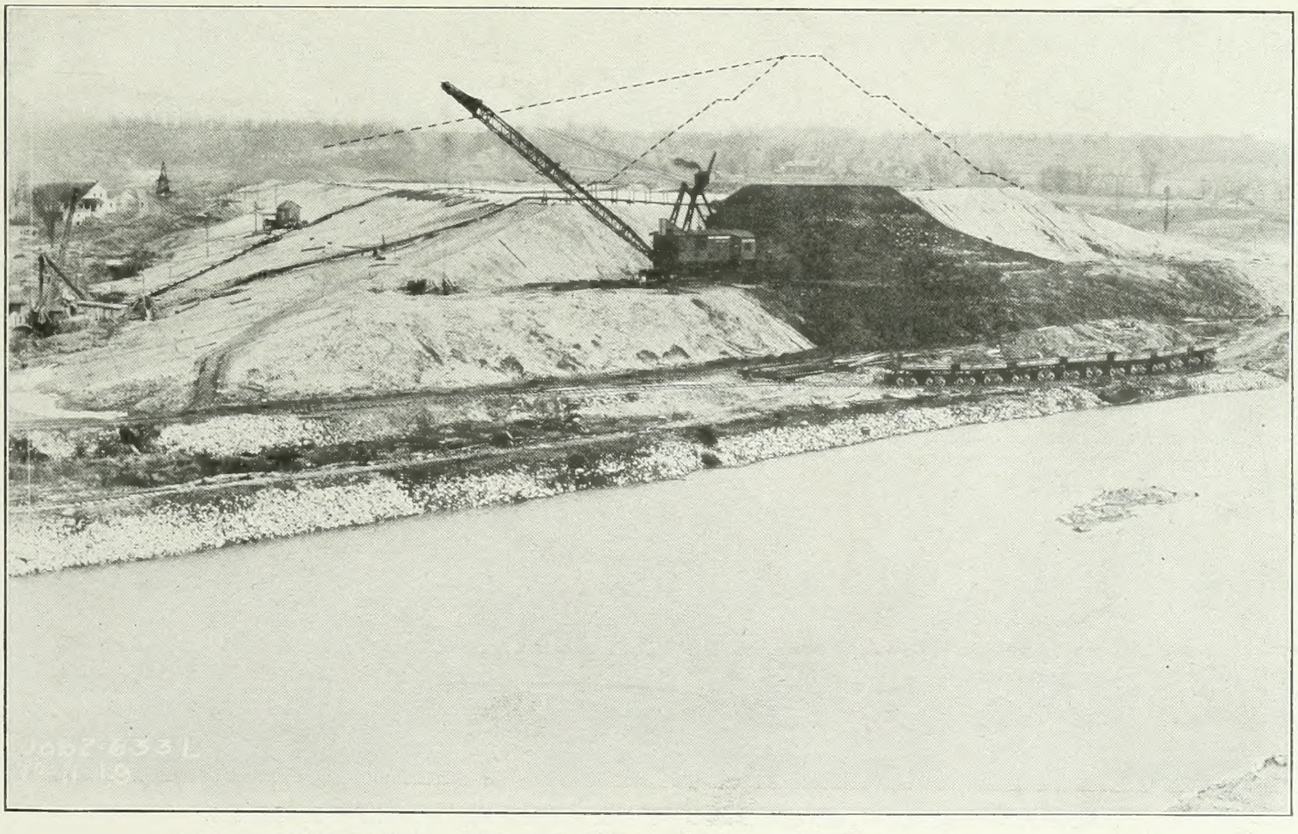

FIG. 99—HYDRAULIC FILL AT ENGLEWOOD, DEC. 11, 1920. SEE PAGE 120

FIG. 100—CONCRETING PLANT, ROBERT BOULEVARD WALL, DAYTON, FEB. 19, 1920.

The 5-ton truck backs up the incline at the right, and dumps the sand and gravel into hoppers at the top, leading to bins. Chutes from the bins lead to a car below, through measuring boxes, to permit exact proportioning. The car climbs the incline beyond the bins, and dumps the measured sand and gravel into a hopper above the mixer, where the proper measure of cement is added. Concrete cars on a track deliver the mixed concrete from the mixer to the forms.

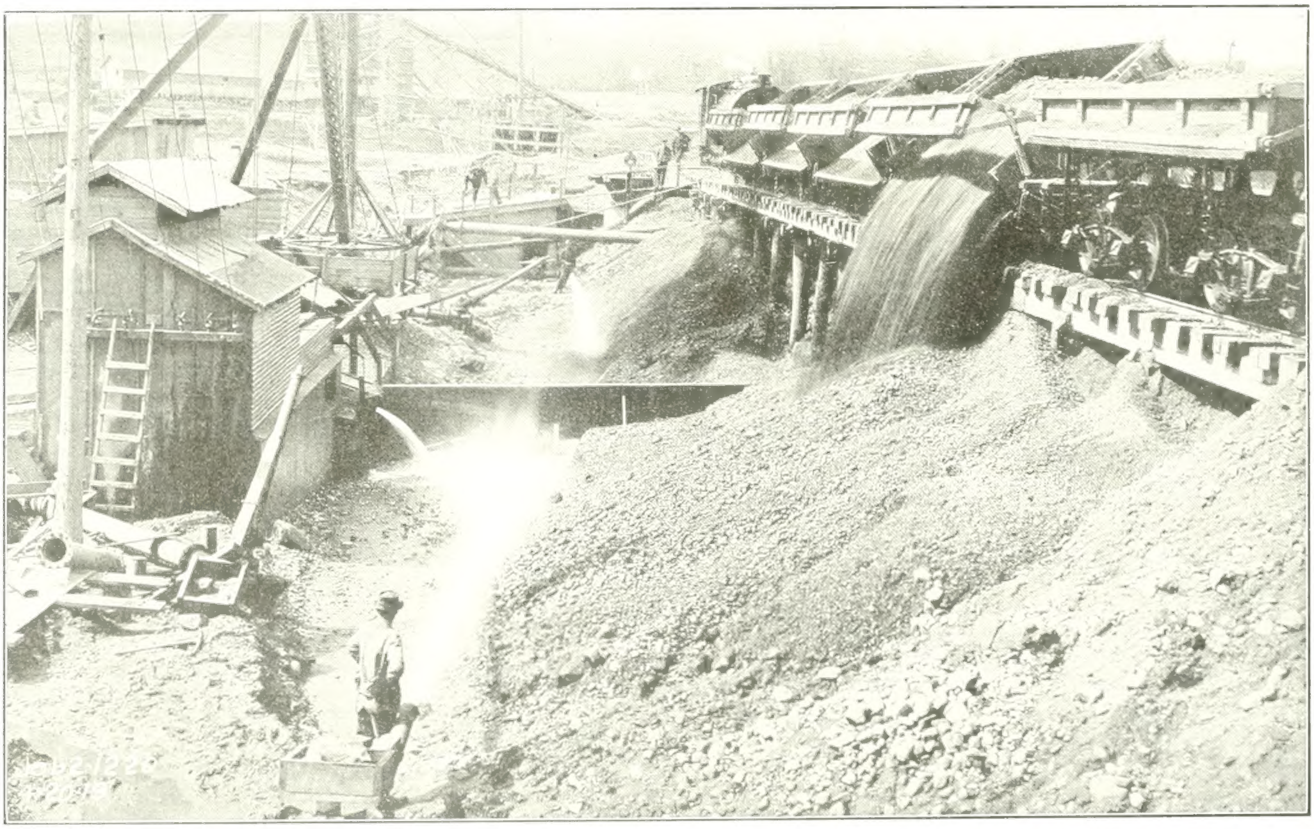

FIG. 101—HOG BOX, ENGLEWOOD DAM, APRIL 20, 1920. SEE PAGE 118.

Essentially a trough 150 feet long and 27 feet wide, with a wall across it in the center. A hydraulic monitor at each end washes the dumped earth down a hole in the trough, in the corner where the cross wall meets the wall at the left. The mixed earth and water are then pumped to the top of the dam by pumps in the house at the left.

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THE MIAMI CONSERVANCY BULLETIN

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Index

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Park Reservations at the Dams

Plans have recently begun to be formulated which in their final effect, and as a "by-product" of the main end of flood prevention, will prove to be a great gain to the whole Miami Valley. The District is obliged to keep control of the banks of the streams for a considerable distance above the dams, in order to maintain a fringe of forest upon them, the object of this fringe being to restrain and retard drift wood, logs, etc., which, driven swiftly down stream in time of flood, might work injury to the dam outlet structures. Also, at each dam site, where the "borrow pits" are excavated which furnish the earth materials to build the dam embankments, there will be, after the work of construction is completed, a considerable lake, which will be connected with the stream. Naturally, the borders of this lake will also be wooded. There is thus created necessarily, at each damsite, a natural park, adorned with woodland, meadow, lake and stream, which only needs a comparatively slight fostering and care by competent hands, to make the most beautiful park and lake system in the state of Ohio. It is a case of true conservation of natural resources, resources which are now in the ownership and control of the public, and which, it is felt, should not be permitted to pass again out of public enjoyment and control. The park areas along the streams will be narrow areas, following the necessities of flood control as already stated. At the lakes, near the dams, the parks will widen, again following work which was necessary to the project. Immediately above the dams, rock riffles will be created, just sufficient to keep the streams nearly bankful for some distance up the valley, and thereby also raising the level in the lakes, thus deepening marshy shore areas which might become mosquito incubators. It is expected that the damsites will by these means become in future times not only an insurance against floods, but a continual resort for health, beauty and pleasure, open at all times to all the inhabitants of the Valley and of the state. The improvement planned will eventually result also, as has been repeatedly proved in similar cases, in a rise in property values.

The Pressure Cells at Germantown

Mention was made in these columns some time since of the installation of pressure cells in the cores of the Conservancy dams, whose object is to determine the rate of solidification of the dam cores by measuring, at various depths, the horizontal and vertical pressures in the earth materials composing them. A technical account of these measurements, and of the conclusions so far deducible, was given in the Christmas number of the Engineering News-Record, and attracted much notice from engineers. The cells, it will be remembered, are imbedded in the core at regular intervals of depth, beginning at the bottom of the dam, the arrangement being such that measurements can be made giving the horizontal pressure, and also the vertical pressure, existing at the cells, at any time. In a liquid, as is well known, the horizontal and vertical pressures at any point are the same. In a perfectly solid material, the horizontal pressure at any depth will be zero, and the vertical pressure, as in the case of a liquid, will equal the weight of a unit column of superincumbent material at the point of measurement. In materials in an intermediate condition of solidification, the vertical pressure will also equal the weight of the unit column, but the horizontal pressure will be something intermediate between that weight and zero. The difference between the horizontal and vertical pressures will thus be a

means of measuring the state as to solidification of the materials in the core. The results at Germantown show that at depths of 25 to 30 feet, the material already shows a very considerable degree of solidification, such as to give good assurance that the core in this respect will be up to the quality desired. Analyses of the soils used in making the hydraulic fill are being made by the Bureau of Soils at Washington. These analyses show small percentages of clay in the finer sizes, indicating favorable materials, and harmonizing with the solidification indicated by the pressure cells. An account of the pressure measurements and the deductions therefrom will soon be published in the Bulletin.

New Osborn

Newspapers of the valley have been printing notices recently in regard to the project of a relocation of the village of Osborn, made necessary by the building of the Huffman dam. Osborn has a population of about 1200 people. It lies so far below the spillway level of the dam that in case of maximum flood it will be ten to fifteen feet under water. Under these circumstances it was necessary to require a removal of the inhabitants to some safer location, and to this end the District was compelled to condemn and purchase the entire body of real estate in the village, legal transfer being made in 1916. Since then there has been a considerable removal of the former property holders, their places being taken, however, by others, so that the population has not diminished but has rather slightly increased. About half the former owners, however, still occupy their property, paying rent to the District. Naturally many of these, probably most of them, are among the more substantial citizens of the village, and as the time draws near when the railways, both steam and electric, will remove to their relocated and rebuilt lines and leave the place, not exactly "high and dry" by the wayside, but something like it, the inhabitants are bestirring themselves to pick up the town also and follow the railways to a new location.

The problem is one never faced before by a town in Ohio. The difficulties are not only physical, financial and social, but legal. There are no precedents to follow. When the villages on the slopes of Vesuvius are overwhelmed by an eruption, and the people driven forth, they move back and rebuild on the fresh layer of scarcely cooled lava, on the old site. But Osborn cannot move back. She must move on. Whither? And how? It is "some problem" for a town of 1200 people to tackle, but they are doing it, and are well on the way to solution. Organization of a company to carry out the project took place at Osborn on March 4. An account of the plans will be published in an early number of the Bulletin.

The Case of Sulphur Springs

Since writing the above the editor has learned of a dilemma somewhat similar to that which faces Osborn—the case of Sulphur Springs, Oklahoma. This town of about 800 inhabitants had grown up in a haphazard way by the "squatting" of white settlers upon Indian reservation lands, around springs of health-giving waters which had given the village its name. Sanitary conditions became such that the springs were being ruined through pollution. By special act of Congress, after careful survey and report by U. S. engineers to the Secretary of the Interior, the inhabitants were paid a fair cash value for their properties, and given ninety days in which to remove to a new townsite laid out on the opposite side of the little valley. It seemed a great trial to the inhabitants at the time, but in the end proved a blessing in disguise. The new Sulphur Springs arose, a much fairer and more attractive place than the old, and the town has since made material gains in size and general prosperity.

"The Reality of the Unseen"

It must have given more than one engineer, as it gave the writer, a strange sensation to sit last Saturday evening and listen while one of the great physicists of the world affirmed his belief in the actuality of inter-communication between the living and the spirits of the dead. We refer, of course, to the lecture by Sir Oliver J. Lodge on "The Reality of the Unseen." We had all heard of Sir Oliver's conversion to the faith he now holds, but no doubt also we had most of us rather discounted it. It was hard to believe. We could not quite realize it. But now there he stood, white-haired and venerable, clothed in a kind of senatorial dignity as one of the great spokesmen for science, and calmly gave the justification—scientific justification—for the faith that is in him. As one might be sure, it is no mere will-o'-the-wisp of cheap spookery which he follows. What he sees goes much deeper and higher. In the age-long warfare between science and religion he bespoke a truce. The champion of science dropped his sword. And it was strange with what gentleness, with what one might call a high humility of spirit, he did it. Prayer, inspiration, and communion with the spirits of the dead, all are realities, he said. Science must follow step by step, investigating by her logical processes these things which she has so often scorned, and so arrive at last "on the mountain top" where religion has, he admitted, already arrived by other means. The thoughtful engineer, accustomed to quite other attitudes in the prophets of science, could only sit and marvel to see this one stating so serenely such convictions.

Touch and Go

Persons who not long since stood on Third Street Bridge in Dayton and watched the men at work laying the last few lengths of gas and water mains across the big trench in the river bottom, probably did not realize just how the engineers in charge were feeling about it. There had been rain—inches of it—and the Great Miami, as is well known, rises to rain "like a trout to a fly, swift and onsartain." It rose nineteen feet above the trench bottom, and within a foot of the top of the frail levee thrown up around the trench by the dragline to keep the flood out. The levee was gravel—the only material obtainable—and leaked like a sieve, the water cascading down the interior trench wall to drown out the pipe line, and the big pumps galloping to keep up with it. The trench once drowned out, with the spring flood season ahead, meant two months probable delay and endless vexation. Luckily the river stopped coming up, and the work was completed. Spectators stared idly and moved on. But the engineers breathed large breaths of relief.

Stream Control and Hydraulic Fill at Englewood

Temporary Spillway to be Built and River Closed This Season. Program for Completion of Dam in 1922. 1,000,000 Cubic Yards of Embankment Now Placed.

By H. S. R. McCurdy, Division Engineer

The first important consideration in the program of construction was the problem of stream control. It must be kept in mind that the Conservancy dams are situated above large centers of population, where any sudden release of impounded water might spell disaster. Therefore the sequence of operations must be so planned as to be safe beyond a reasonable doubt, even should a repetition of the great 1913 flood occur. This is done in two ways, depending upon the type of outlet works. At Lockington, Huffman and Taylorsville the outlet works, as previously stated, are simply openings through the lower portion of the spillway weir. It is, therefore, a simple matter to construct the bottom and side walls of the structure, making an admirable flume for the passage of water. The weir itself is not built in until the dam has reached a safe height. For the covered-conduit type of outlet works, as at Englewood and Germantown, however, the stream control problem offers greater difficulty. Here it is necessary to retain the original waterway or provide an artificial one until such time as the adjacent portions of the dam can be carried up to an elevation of safety, and subsequently to make the closure during the season of low flows. At Germantown the problem is simplified by the narrow valley and the yardage involved in raising the embankment clear of the danger point is sufficiently small to permit the river closure to be made this season. In fact, the work is now at a safe height. These closures are greatly facilitated by building the outlet conduits with a temporary carrying capacity about double that in the finished design, thus diminishing the retarding action of the dams in a corresponding ratio.

At Englewood the stream control problem is somewhat complex. The country is so flat that a closure entirely across the river valley during one low-flow season is not to be thought of. The alternative, therefore, lies in what amounts virtually to building the dam in sections. The first season a cross dam is built on the east bank of the river. This cross dam is nothing more or less than a short section of the main embankment built from toe to toe, to serve as a retaining wall for the end of the hydraulic fill. Where this cross dam lies within the outer portions of the main embankment it is built of porous material; where it crosses the middle portion of the main dam impervious material is used. Thus the composition of the main dam from end to end is not interfered with by the fact that the cross dam is interposed. The latter is carried up only fast enough to keep well clear of the hydraulic fill. The impervious middle portion is rolled in 6-inch layers, using a 12-ton steam roller. The sand and gravel shoulders are pumped into place as part of the main hydraulic fill.

With the cross dam in place to elevation 840, something over a million yards of hydraulic fill can be pumped without disturbing the river channel. This is a good season's work. In the meantime west of the river a temporary spillway, guarded on the east by a cross dam carried to elevation 850, will be constructed, and next April, with about nine or ten months of immunity from severe floods ahead, the river closure can be made and the hydraulic fill carried up to elevation 850. The third season sees a comparatively easy closure of the temporary spillway, and no further worry from flood flows, even should a repetition of the 1913 flood occur. The dam should be completed the fourth season. An inspection of Fig. 102 will make the foregoing program clear.

The Englewood borrow pit is located upstream from the dam, as will be seen in Fig. 103. The material is excavated by means of two 115-ton dragline excavators, one electric and the other steam, equipped with 85-foot booms and 4½-yard buckets. The draglines are ranged along the same track, one about 1,000 feet in advance of the other. An inter-

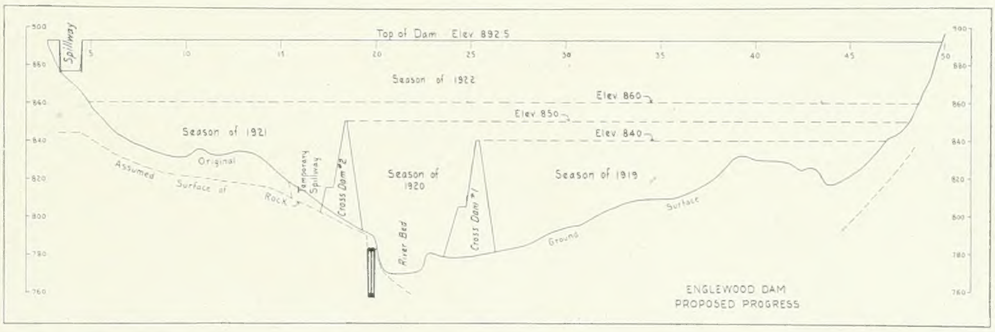

FIG. 102—CONSTRUCTION PROGRAM FOR ENGLEWOOD DAM EMBANKMENT

The program calls for the finishing of the work in four seasons, ending in December, 1922. The horizontal line at the top shows the finished elevation of the top of the dam. The irregular line at the bottom is a cross section of the Stillwater River valley on the dam center line, at the beginning of the work. The three dotted lines show respectively the elevation reached by the growing embankment at the end of the working seasons of 1919, 1920 and 1921. The embankment built during 1919 is entirely on the east valley slope, ending at Cross Dam No. 1, shown on the east bank of the river. The coming season will carry the top of this embankment up to elevation 850, and across the old river bed to the top of Cross Dam No. 2, which will be built during the early part of the season, the river meantime being carried in the concrete conduits shown just at the west edge of the river bed. (They appear very high and narrow, due to the fact that the vertical scale of the drawing is much exaggerated.) Any flood during this season will be carried by a temporary "spillway" shown just to the left of Cross Dam No. 2. 1921 will see the top of the dam carried to elevation 860, and 1922 to elevation 892.5, 122 feet above the old river bed.

esting comparison is offered as to the relative merits of steam and electricity as power for machines of this type. With electricity at slightly less than 1.6 cents per kilowatt-hour, the steam dragline is somewhat more expensive. The latter is more rapid in operation, but the cost of coaling runs the unit cost above that of the machine using electrical power. The depth of face in the pit averages perhaps 15 feet, and the draglines load into standard-gage 12-yard air-dump cars. Under these working conditions each machine can comfortably move from 150 to 180 cubic yards per hour. A double-track system is arranged, with suitable crossovers, in such manner that no interference occurs in the handling of trains.

There are four trains from the borrow pit containing seven cars each, which are handled by 40-ton locomotives. They climb a 2-per cent compensated grade onto a trestle 175 feet long, paralleling and close to the upstream toe of the dam. From the trestle the cars dump into what has been given a name more practical than euphonious—"the hog box." One standing at a point of vantage and watching the material snouted and swilled to the sump by the sluicing giants can readily see the application. The hog box is essentially a trough 150 feet long and 27 feet wide, ranged alongside the track from the borrow pit which, at this place, is carried on a pile trestle. The floor of the hog box is 13 feet below the rail and cones at approximately 4 per cent to an opening in the opposite side from the track. The opening discharges into revolving screens through which the material passes to the sump. The sump is a concrete well, 8 feet by 16 feet, divided by a partition into two chambers 8 feet square. The bottom of the sump is 16 feet below the floor of the hog box.

The material as dumped from the trains into the hog box may be dry or wet, according to whether the draglines happen to be digging above or below ground-water level. As the material lies in the hog box, it is washed through revolving screens into the sump by means of two hydraulic giants or monitors, one at each end of the hog box. Pressure for this sluicing water is furnished by two 10-inch centrifugal pumps, operating at a speed of 1760 revolutions per minute and each driven by a 100 horsepower motor. The pressure is kept at about 60 pounds and the jet is directed through a 3-inch nozzle.

The revolving screens are the product of several rejected schemes for eliminating the oversize rock from the material being fed to the dredge pumps. At first sloping gratings of several types with square openings were tried. These were fairly satisfactory when the material was not coming too fast or when there was not too great proportion of clay lumps. At such times the tendency was for the gratings to clog. Furthermore, each grating required the services of three men, clearing away the material. But the revolving screens seem to have effected a complete and simple solution of the rejection of oversize. The screens are cylindrical in shape, 4 feet in diameter, have an effective screening length of about 9 feet and are pierced with 6-inch circular holes in one case and 6½-inch holes in the other. The latter size is in the last screen installed and is an attempt to use the largest size openings without choking the dredge pumps. While the 6½-inch holes are satisfactory it is not known as yet whether or not this size can safely be increased.* The screens pitch ½ inch to the foot. The first screen installed was given a speed of 14 revolutions per minute, but in its companion, installed later, the speed has been reduced to 9 revolutions per minute, and seems to give, if anything, more efficient service. Each screen is operated by a 7½ horsepower electric motor, chain-connected, the reduction in speed being accomplished through a countershaft. From the screens the acceptable material drops directly into the sump, while the oversize rock goes out of the end into bottom-dump buckets which are hoisted out with a stiff-leg derrick and dumped into a standard car in which they are hauled away to the downstream slope of the dam. Not only do the revolving screens serve to reject the oversize rock but, in addition, they fulfill another most important function. The tendency of the giants, even with the most skillful handling, is to wash the material into the sump in masses. Thus, one minute the dredge pumps would be handling comparatively clear water while the next they would be staggering to clear themselves of an overload. The action of the revolving screens, however, tends to rectify this irregular feed and to deliver the material to the suctions of the dredge pumps in a uniform flow. It is of the utmost importance that this delivery of the mud to the pumps be as uniform as possible. A neglect of this has a dire effect upon the output.

Directly beneath each screen is an inverted truncated pyramid with an opening 2 feet square directly above the suction of the dredge pump. The object of this is to remix the fine material passing one end of the screen and the stones passing farther on. The suctions from the dredge pumps are inclined at an angle of 45 degrees from the vertical, and in order to lead the material to them along the easiest lines the floor is shaped as an inverted pyramid. It has been found that with a flat floor the mud has a tendency to pile up until at some point a great mass will slough off and bury the suction. Then comes the plug and a vexatious delay until the suction pipe is cleared.

The business end of the hydraulic-fill plant is the dredge pumps. At Englewood the present installation comprises two 15-inch centrifugal pumps, designed for 150-feet head, operating at a maximum of 505 revolutions per minute and each driven by a direct connected 500 horsepower variable speed slip-ring induction motor. These pumps are made of cast manganese steel, containing perhaps 5 or 6 per cent of manganese (although the makers have not disclosed this). As yet this particular alloy seems to be by far the best fitted for standing the abrasive wear of sand and gravel. The shell of these pumps is from 2½ to 3 inches in thickness, depending upon the place. An item of the utmost importance is the design of the impeller, a matter which is complicated by the range of head against which the pump is called upon to operate. For instance, at Englewood the dredge pumps are working under heads which at the beginning are not more than 25 feet, but which are steadily increasing until a maximum of 150 feet will be reached, at which point a booster pump will be inserted in the line. To compensate for this variation, different sized runners are being tried, a smaller one for the lower heads and increasing in size as the heads shall increase. This arrange-

* Seven-inch holes are now in successful use.

ment is adapted to develop more fully the power of the motors. With a large runner operating against low heads the pump and water must run at low speed, and hence a large percentage of horse power is wasted in heating the grids used for lowering the speed. Diameters of runners of from 38 inches to 46 inches are being tried, but as yet it is too early to state results. The matter is, however, one of importance and will be carried along to definite conclusions.

The life of one of the manganese steel pumps as at present designed, pumping sand and gravel, is slightly less than 200,000 cubic yards. At Englewood the second pair of pumps is now in service, but the designers are making modifications in design for future deliveries, from which are expected better results. The impellers show wear at 50,000 cubic yards, but can be used, with doubtful efficiency, for perhaps 100,000 cubic yards. The consensus of opinion among those studying the operation of the pumps is that it does not pay to use equipment after it is badly worn. Economy is better served by scrapping the old shells and runners the moment they show signs of letting down. Inasmuch as the dredge pumps are the neck of the bottle, and the entire organization is succeeding in its purpose only to the extent that the pumps are functioning, it is obvious that they should operate at the highest pitch. To increase the life of the impellers, renewable shoes, for the wearing parts, are now being successfully used.

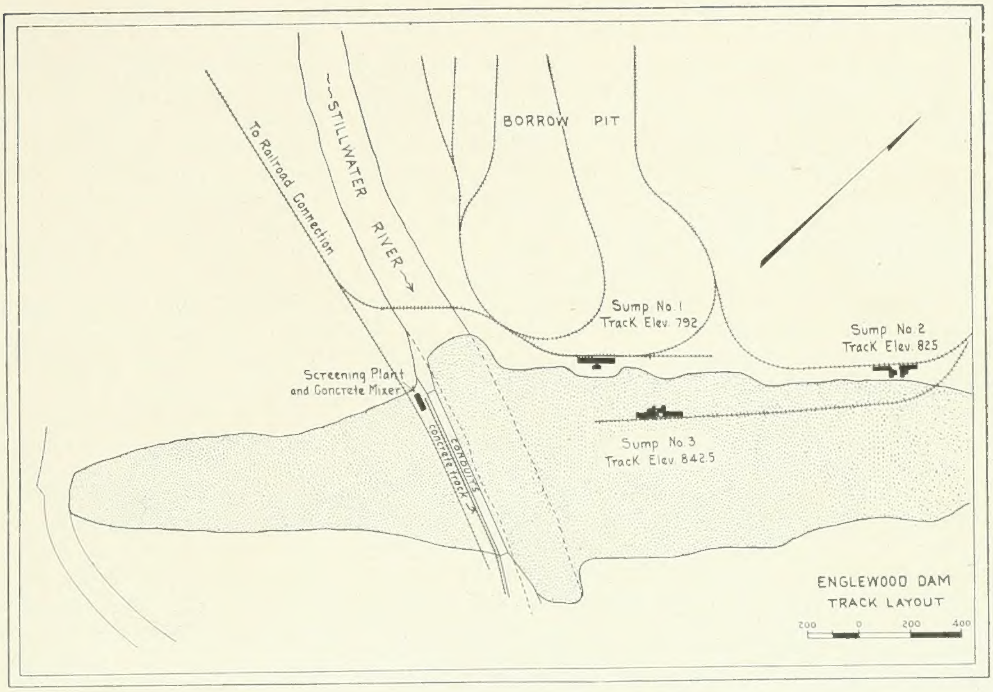

FIG. 103—TRACK LAYOUT, ENGLEWOOD DAM.

The stippled area is the outline of the dam as finished. The sumps are shown in black on the east (left) slope of the river valley. No. 1, on the valley bottom, was used last season and is now used only as water supply for monitor pumps. Sump No. 2 is up the slope, at 33 feet higher elevation. Sump No. 3 is on a berm of the dam embankment, 17.5 feet still higher. Materials excavated from the borrow pit above the dam site are carried in dump cars to the sumps over the tracks shown. A hog box, pumps, etc., are at each sump, the operation being as described under Fig. 101. The pumping for the embankment for 1920, as shown in Fig. 102, will be done from sumps Nos. 2 and 3.

The operation of the dredge pumps and monitor pumps requires about 31 cubic feet per second of water. The location of the sump is 450 feet from the river. Rather than pump the water this distance a 4-foot corrugated-iron culvert was laid, through which the water flows by gravity. Near the sump a concrete well was built in the line to serve as a sump for the monitor pumps. Each of the two monitor pumps handles 2,000 gallons per minute. The nominal capacity of each dredge pump is 7,000 gallons per minute, which is the amount to be provided for, inasmuch as the discharge from the monitor pumps feeds into the sump.

The dredge pumps pick the material up from the sump and discharge it to the dam through 15-inch pipe. Where the pipe line runs up the side of the dam, and is therefore more or less permanent, the heaviest class of standard cast-iron flanged pipe is used. For the shore lines, however, where the pipes are changed for each run, a lighter pipe than the cast iron—one that can be handled with rapidity and ease—is required. For this purpose one of the large rolling mills is manufacturing a special welded high carbon steel pipe. This metal contains 0.50 to 0.60 per cent carbon and about 0.75 manganese, the product beyond these limits being too stiff and springy to keep the curvature given by the rolls. The pipes are slip or stove pipe joint, i. e., have a slight flare at one end, and are held together by wire stretched over hook lugs. The thickness of shell is 11/64 inches, the pipes are in 16 foot lengths and weigh 28.83 pounds per lineal foot. It is not known just what the life of these manganese steel pipes is, for the very good reason that, to date, none have worn out. The greatest yardage that any of the pipes have passed to date is about 300,000. Riveted steel pipe, made from ordinary steel plate containing 0.10 to 0.20 carbon, proved very shortlived. Claim has been made that the high carbon pipe will last ten to fifteen times as long as ordinary steel, and this may prove to be so. To insure an even wear around the circumference of the pipe, they are turned 120 degrees for each new run. Observation shows that practically all of the solids flow within the lower third of the pipe, the upper two-thirds being filled with water bearing only the lightest particles. Consequently, for a given run it is the lower portion of the pipe only which is subjected to any considerable wear. No difficulty is experienced in practice in doing this; one end of each pipe is numbered 1, 2, and 3, 120 degrees apart,

and each time a line is relaid the pipes are revolved until the next number is uppermost.

The trick in pumping earth materials seems to lie in developing the consistent maximum capacity of the pumps and then feeding them uniformly to that capacity and no more. If the pumps are not receiving all the solids they can handle, money is being wasted. If, on the other hand, the pumps receive more than they can handle for any considerable time, a plug ensues and the entire pumping outfit spends many profane hours in clearing out the pipe—not a pleasant or easy job at best. Of course, short overloads, if not too heavy, can be handled by the reserve power in the motor, but there is a limit to the length of time this reserve can be applied without injuring the motor, and also a limit to the amount this power can handle. The whole method involves a synchronizing of effort on the part of the monitor men and the pump runner. Either working without due regard to the other can waste efficiency or plug the system. If the pump man does not throw in an extra finger on the switchboard at exactly the same time that the monitor men are crowding the dirt, trouble ensues. At Englewood the first plan for coordinating the various operations consisted in establishing a control tower overlooking the hog box. Here were installed pressure and vacuum gages, electric-bell connections to pump man and monitor men, and connections with portable telephones at the end of the pipe lines. By his electric-gong signals the foreman in the tower could direct operations—signal the monitor men for more or less feed, as the case might be, or notify the pump man to increase his power. This was a big advance over anything tried before, but it had one weak spot—the gages in practice did not always operate as swiftly or as surely as was desired. Sometimes the line would plug before the gages had given warning. But the difficulty has been solved by a very simple little device. The first sign of plugging in the pipe is manifested by a reduction of velocity. This at once becomes apparent at the discharge from the pipe lines by a slackening of the issuing stream. With this in mind the resident electrician, Mr. H. S. Knerr, rigged up a small attachment, consisting essentially of a steel clapper working on a hinge and forming contact at one end with an insulated wire running to the pumphouse, and at the other end with the jet from the pipe. The theory of the contrivance is that, with a full jet issuing from the pipe, the clapper is pushed against the contact points and the circuit is closed, but as the jet falls the contact breaks and the circuit is opened. Connected in the circuit are incandescent lamps, one at each monitor and one at each pump. Thus the monitor men and the pump man are constantly and instantly informed as to the condition of flow through the pipe, and can govern themselves accordingly. This simple device has resulted in a marked increase in the output and has borne a large share in the elimination of plugs.

Studies are being made, as the dam progresses, of the behavior of the core. It is known that it is becoming stiff at the lower elevations. A 1½-inch diameter pole shoved into the core meets sensible resistance at about 15 feet. The stiffening increases until at 25 or 30 feet a man's weight will force the pole no farther. It is the intention to test the rate of stiffening in the core by noting the penetration of a 6-inch cast iron ball. By this means a direct comparison can be had between the cores at the five Conservancy dams. Furthermore, this ball method was in use at the Calaveras Dam for the Spring Valley Water Company in California, and comparisons in penetration can be had with that dam. It is also the intention to insert in the core a number of pressure-recording devices, developed by the Engineer of Tests, Bureau of Public Roads, Washington, for the purpose of measuring pressures in semi-fluid masses.

At the time the pumping plant was laid out very little authentic data was available in reference to friction head in dredge pipe. It was thought that, with velocities of 12 feet per second, the loss of head would be about 4 feet in 100 feet. In the clayey glacial till, such as is being pumped at Taylorsville, this is approximately true, but in the gritty sands and gravels at Englewood and Germantown, using velocities of 12 feet per second or upward, it is found that the friction head is unexpectedly large, amounting to as much as 8 feet per 100 feet. Such a condition throws a heavy penalty upon length of discharge line, and accordingly, at Englewood, studies are being made to abandon the present sump late this season and to use, progressively, three other sumps so located as to reduce both static and friction head to the least amount compatible with securing a satisfactory railroad grade from the borrow pit.

A matter entering vitally into the rate of progress of the hydraulic fill is the per cent of solids in the water handled by the dredge pumps. At times clear water is being pumped; at others as much as 15 or 20 per cent of solids is carried for short periods. The present average is probably from 6 to 10 per cent. Obviously, the higher the percentage the lower the unit cost, and studies are being made along these lines to find out just what can be handled. In the first place, there is vast room for improvement in the sumps. A sump is now being designed at Englewood from which much is expected. The principle being followed is to drop the material passing the revolving screens into the path of the water flowing to the suction of the pump and to fashion the entrance to the suction into a bellmouth to reduce the loss of head at entrance. But it is one thing to get the material into the pump and another to pass it through a long discharge line without plugging the latter. This feature is engaging the attention of the engineering force and studies are under way looking to some form of spiral or rifling device which will keep in suspension the solids in the discharge pipe and offset the tendency to settle in the bottom of the pipe.

The monthly progress at Englewood, working two 15-inch dredge pumps, two shifts of ten hours each, has averaged 85,000 cubic yards. Some minor changes in the screens and sump have lately served to increase that figure so that at present (September 1) each pump is delivering consistently 150 cubic yards per hour, or a total for the two of 6,000 cubic yards per day. The total amount pumped to Jan. 1 aggregates approximately 834,000 cubic yards.

(Note on front cover picture. The upper dotted line shows the final elevation. The other dotted lines indicate the shape of the cross section. The old river bed is in the foreground. The section seen is about 7/12 of full height and contains 1,000,000 cu. yds.)

The pumping must begin promptly on April 1. To do this, sumps and scows must be built, pumps set, spillway laid, tower erected, etc. These operations take different periods of time to complete. Often one must be finished before the next can begin. All these relations the diagram shows clearly. The vertical divisions represent days of the month, the dates being indicated by names and numbers above and below. The horizontal rectangles represent the various jobs of work to be finished for the pumping. "Building Sump No. 3" must begin on Feb. 16 and end on March 24. On the latter date also must end the work on pumps, motors, spillway, scow, etc., all of which must then begin tuning up together, as indicated, for the work on the actual fill on April 1. Each foreman has a copy of this diagram.

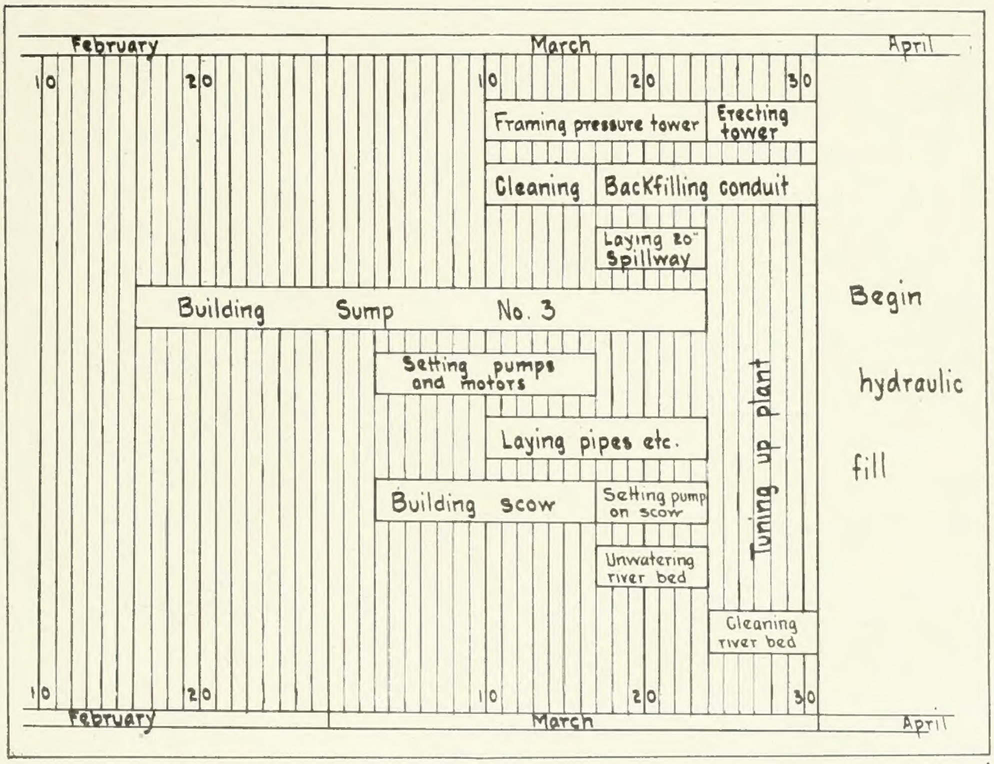

FIG. 104—WORKING SCHEDULE PRELIMINARY TO HYDRAULIC FILL FOR 1920 AT THE ENGLEWOOD DAM.

January Progress on the Work

GERMANTOWN

Work on the hydraulic fill was carried forward with difficulty during the cold weather. During the month of January 42,500 cubic yards were placed, making a total to date of 412,400 cubic yards. This is approximately 52 per cent of the total hydraulic embankment. On February 6th, the work on the hydraulic fill was suspended, the upstream slope of the dam having reached elevation 780, which point is was necessary to attain to prevent overtopping by a possible repetition of the 1913 flood.

Since the hydraulic fill has been shut down the workmen have been engaged in making necessary repairs to equipment and hog box, so that they will be in good shape for work when warm weather comes. While the equipment is in the process of repair, a booster station is being built on the second berm of the dam, and it is planned to begin pumping with the booster as soon as operations are again started.

A new track is also being constructed along the borrow pit for future excavation.

Arthur L. Pauls, Division Engineer.

February 14, 1920.

ENGLEWOOD

The past month the working forces have been engaged in various preparatory measures for prosecuting the work during the coming season. Sump No. 2 is practically completed. The dumping trestle for Sump No. 3 and the excavation for the pump houses are practically finished. These sumps are the pumping installations by means of which the hydraulic fill will be placed into the dam. They are built at points located by an economic adjustment of the haul by train and the height and distance necessary to pump the sluiced material.

To protect the motor operating the monitor water supply pump against flooding after the river closure shall have been made during the coming summer, a scow has been built. Upon this scow the pump and motor will be installed, connected with the pipe line up the slope of the dam by pipes fitted with flexible ball joints. By this means the pumping plant can readily rise and fall with the water in the retarding basin during floods and still operate.

The steel sheet piling, driven to form an effective cut-off at the easterly bank of the Stillwater River, has been completed and the pile driving equipment shipped to Huffman. Thirty-nine hundred square feet of ⅜-inch arched-web piling, 35 lbs. per sq. ft. of wall, extending over 152 lineal feet, have been driven. Over the greater portion of its length these piles were driven to a firm seat upon the underlying ledge rock.

Track approaches to the new sumps have been graded and ballasted, dragline and locomotive boilers have been re-flued and various plant repairs made.

Soundings have been taken through the ice in the hydraulic core pool to ascertain the degree of hardening which has taken place in the core of the dam. The indications are that the clay and silt mixture, which was deposited in suspension, is stiffening satisfactorily.

H. S. R. McCurdy, Division Engineer.

February 16, 1920.

LOCKINGTON

Due to unfavorable weather conditions, the dredge pumps have been forced to remain idle. A second dredge pump unit of manganese steel has been installed and is ready for service. The pipe lines supplying water to the monitors have been relocated.

The overhauling of the Class B dragline has been completed and as soon as the weather permits this machine will resume its operations, excavating the cut-off trench across the valley bottom east of the outlet structure.

The gravel surfacing of Road No. 8 has been completed, with the exception of a short stretch near its east end. The gravel was obtained from a pit near the south end of the road.

Clearing of the timber along the creek banks north of the dam has progressed favorably.

A working force has been maintained large enough to carry on the scheduled winter work and to start hydraulic filling in the spring.

B. M. Jones, Division Engineer.

February 24, 1920.

TAYLORSVILLE

The progress of the rock excavation for the outlet works shows slight improvement over the two preceding months. The excavation from the part of the channel that is to be lined with concrete is now finished. The Lidgerwood will continue on upstream with the excavation of the inlet channel.

The Bucyrus dragline, Class 14, has moved back to the north end of the west gravel pit and gravel is being taken from this pit now for concrete, as the sand from it is much more satisfactory than that obtained from the east pit.

The progress on the concrete has been only fair, but probably as good as could be expected with the weather and the labor shortage. The gravel washing plant and the mixing plant have been enclosed and heated so that concrete can be placed in the forms at a temperature of from 50 to 60 degrees, even in zero weather. But the cleaning up of the rock excavation ahead of the concrete becomes very slow and expensive when the temperature is not above freezing for a good part of the day.

The heavy ice has gone out of the river, giving but little trouble. This was due to a few warm days without any rain to cause high water.

O. N. Floyd, Division Engineer.

February 16, 1920.

HUFFMAN

As noted in the February Bulletin, the placing of hydraulic fill in the dam was discontinued on January 9th, on account of unfavorable weather conditions. The cold weather has been very continuous since that time, with the exception of the period from February 5th to 14th, when pumping was continued very satisfactorily. Another cold snap beginning the 14th has forced a second shut-down, continuing to date. The ten-day run gave a good opportunity to test out the booster pump that had been installed during the January shut-down. The operation was very satisfactory, and the value of using this booster pump on the long distance discharge pipe lines was verified. When pumping on the long line to the north end of the dam the hourly output was increased over 50 per cent with the booster pump in use over that obtained when using only the primary pump and the same length of line. The value of this booster pump decreases as the pipe lines are shortened, so a by-pass has been built to allow the elimination of the booster on the shorter lines, when the primary pump alone is able to maintain the proper rate of output.

The Lidgerwood steam dragline has completed the raising of the cross dam north of the diversion channel. This has been built up to an elevation that will take care of all the pumping that can be done until danger from spring floods has passed sufficiently to allow the closing of the gap between the cross dam and the concrete wall.

A cut-off trench is being dug with the steam dragline across the old bed of Mad River, and along the center line of the dam, in which steel sheet piling will be driven. Preparations are being made to drive this piling as soon as the trench has been completed.

C. C. Chambers, Division Engineer.

February 21, 1920.

DAYTON

The principal work carried on during the past month has been the dismantling of dragline D-15 at Herman Avenue and its re-erection at Stewart Street, the erection of dragline D-8 at Sunrise Avenue, and the overhauling and repairing of dragline D-19 at Webster Street. This work is progressing satisfactorily and is being done at a time when it least interferes with construction, because of the deep frost and ice conditions. Dragline D-16 has continued with the work of lowering the gas and water main across the river at Third Street. Little channel excavation, therefore, has been removed during the month.

A stone crusher has been installed at the gravel plant to crush the oversize material.

About 10,000 feet B. M. of lumber has been salvaged from the temporary dam structure opposite Sunset Avenue.

Fair progress is being made with the construction of South Robert Boulevard wall, 1415 cubic yards of concrete having been placed to date.

Channel excavation to date amounts to 674,000 cubic yards. The total pay quantity in spoil banks and levees is 483,000 cubic yards, including 60,000 cubic yards of levee embankment on Contract No. 41. In accomplishing this work the total yardage handled amounts to 1,195,300 cubic yards. None of these figures include excess excavation from the launching basin and scowing channels, which amounts to 38,700 cubic yards, and which was taken out for construction purposes only.

C. A. Bock, Division Engineer.

February 20, 1920.

HAMILTON

The total material handled to February 1, including contract work, was 1,099,000 cubic yards. The total amount of Item 9, channel excavation, was 570,000 cubic yards.

The electric dragline is working on the east side of the channel between the Columbia bridge and the railroad bridge. During January this machine loaded on cars 43,000 cubic yards of Item 9. The material being excavated at the present time is being hauled into the site of Price Bros. concrete block plant. The piling is being delivered for the trestle north of the Columbia bridge, the contract for the driving having been awarded to Price Bros.

The steam dragline has completed the excavation and pile driving for the concrete wall at the northeast corner of the Main Street bridge. Sixty feet of the footing have been concreted. The wall south of the soldiers' monument has been completed.

The steam dragline has moved to the west side of the river, where it will excavate for the wall at the southwest corner of the Main Street bridge and then build the levee south from this point.

C. H. Eiffert, Division Engineer.

February 19, 1920.

LOWER RIVER WORK

Construction work in the towns of Miamisburg, Franklin and Middletown is at a standstill, the contractors having shut down on account of cold weather and the depth of frost in the ground.

F. G. Blackwell, Assistant Engineer.

February 16, 1920.

RAILWAY RELOCATION

Big Four and Erie. The Big Four tracklaying is completed and the Erie will be completed March 1.

The Fairfield Signal Station is about 50 per cent complete. The ground work is well under way, as well as the signal tower. Progress on the Tates Point Signal System has been held up on account of the weather. The Western Union have erected all their poles and are now setting the cross arms. One pole line will be constructed for both railroads.

Grading for the highway at Huffman at the overhead bridge is in progress. The overhead bridge is almost complete with exception of the hand rails.

The ballasting will start as soon as weather will permit.

Ohio Electric. The contract for the steel superstructure for the bridge over Mad River has been given to the Brookville Bridge Company.

The tracklaying will soon be started on this line. Some of the ties have already been distributed.

Baltimore & Ohio Railroad. The work on this line has been confined to the installation of the automatic block signal system. All other work has been suspended on account of the weather. The ballasting of the track will be resumed as soon as weather will permit.

The Baltimore & Ohio Railroad's own forces have been working on the track raising and bridge elevation of the Miami River bridge, No. 3, during the winter months and the work is nearly completed.

Albert Larsen, Division Engineer.

February 16, 1920.

RIVER AND WEATHER CONDITIONS

The only unusual feature of the river and weather conditions during the month of January was the large amount of ice on the ground from the 24th to the end of the month. This was caused by the melting and freezing of about 8 inches of snow which fell during the earlier part of the month. A rainfall of about a quarter of an inch on the 23rd, after which the temperature again fell to below freezing, aided in changing the snow to ice.

The rivers were comparatively low throughout the month. The total precipitation varied at the District's stations from 0.35 inches at Ingomar to 2.32 inches at the Germantown Dam. The maximum 24-hour rainfall occurred on January 9, varying from 0.91 inches at the Ger-

mantown Dam to 1.10 inches at Fort Loramie. At the Dayton Weather Bureau station the total was 1.80 inches, or 1.21 inches less than normal.

Observations taken by the local U. S. Weather Bureau show that the mean temperature for the month was 23.4 degrees or 6.6 degress less than normal; that there were 7 clear days, 8 partly cloudy days, 16 cloudy days, and 14 days on which the precipitation amounted to or exceeded 0.01 of an inch; that the average wind velocity was 11.6 miles per hour, the prevailing direction being from the northeast; and that the maximum wind velocity for 5 minutes was 36 miles per hour from the northwest on the 2nd.

Ivan E. Houk, District Forecaster.

February 23, 1920.

Proportioning Concrete Materials at the Taylorsville Dam

Saturation of Sand to Give Constant Volume of That Material in the Mix. Economy Furthered by Rejecting Buckshot Sand and Pea Gravel.

The amount of concrete to be placed in the outlet structure at Taylorsville is the largest at any of the dams, comprising about 55,000 cubic yards. The type of the structure is the same in general as that at Huffman and at Lockington, already described in these columns. (See Bulletins for August and September, 1919). The work is massive, requiring reinforcement only in a few special places. The materials for the aggregate, as well as the sand, are obtained from gravel pits in the valley bottom below the dam site. They are screened and washed in a special plant erected near the work to be done, of a design described in the Bulletin for April, 1919. Before beginning to place the concrete, it was advisable to make a preliminary study of the sand and gravel to be used, in order to obtain the most economical mix which would give the desired strength. The investigation was carried out by Mr. H. R. Daubenspeck, Assistant Engineer, under whose direction the screening and mixing are carried on, and the results of his work are presented in the following article.

The screening and washing plant is shown in Fig. 105. It delivers to the bins sand of all sizes from ¼ inch down; fine gravel from ¼ inch to 1½ inch; and coarse gravel from 1½ inch to 3 inch. Material rolling through the upper (3 inch) screen is chuted into the coarse gravel bin, up to 6 inches in diameter. The proportions of these grades, as the material comes from the pit, are quite variable. On the average, the fine gravel exceeds the coarse by about 50 per cent. The grading of the fine gravel and of the sand is also variable over considerable limits, giving rise to difficulties with the mix unless careful watch is kept.

With materials of this kind to deal with, it was of course out of the question to apply fine spun theories to the proportioning of the concrete. Broad considerations, based on simple relations of grading to voids, which really underlie all the theories, formed the basis on which the experiments were carried out. It was determined to make the conditions under which the tests were made conform as closely as possible to those under which the concrete would be actually mixed. The ends sought were immediate and practical, having direct reference to the materials to be used.

Tests were first made to determine the combination of the two grades of gravel which would produce the densest mix. As figure 105 indicates, the sand and the two grades of gravel are fed to the concrete mixer by gravity through separate chutes, in which are inserted measuring boxes for getting the proper proportions of the materials. These measuring boxes were carefully calibrated and used to measure the gravel for the tests, the mixing of the two grades being done by the concrete mixer, exactly as in actual concreting. The mixed ma-

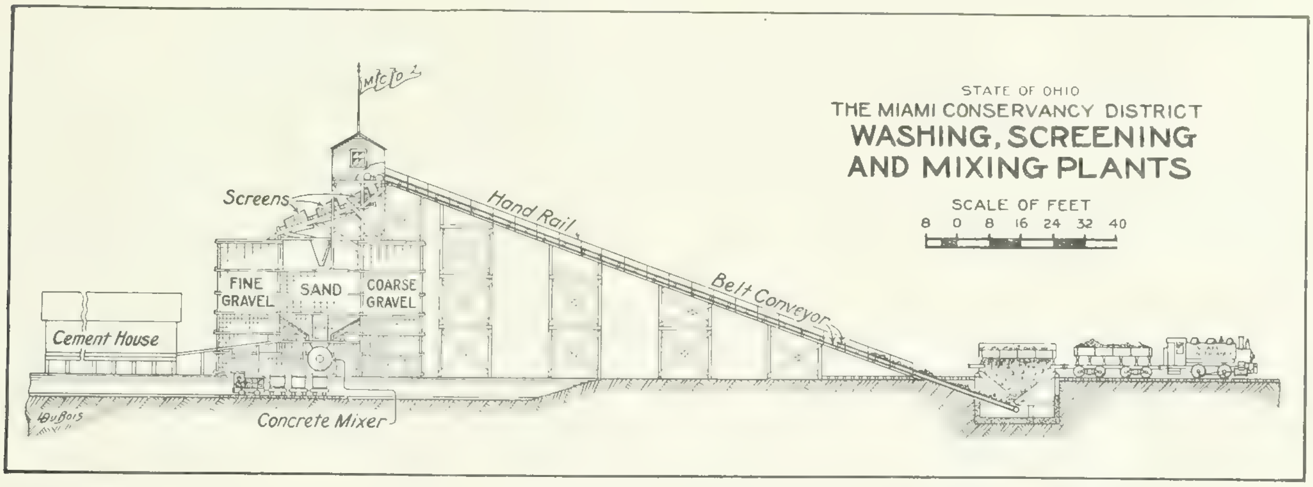

FIG. 105—GRAVEL WASHING AND SCREENING PLANT.

The materials from the gravel pit, brought by train, are dumped into the hopper at the right, whence they are elevated to the top of the washer by the belt conveyor, and dumped into another hopper. Thence they pass successively to the three conical screens, which revolve on inclined axes, as indicated, and separate the materials into sand, and two grades of gravel, fine and coarse. The finer screen is shown in Fig. 106. Jets of water wash the materials as they are screened. Chutes lead the several grades to the three bins marked in the diagram. From the bins other chutes lead to the concrete mixer, the materials passing through measuring boxes built into the chutes, by which they can be combined in proper proportions to form the concrete. The cement is wheeled to the mixer from the cement house in barrows.

Table 1

Test No.	Coarse Gravel* [illegible] to 3" Cu. ft.	Coarse Gravel % of mix	Small Gravel [illegible] Cu. ft.	Small Gravel % of mix	Total Volume Before Mixing Cu. ft.	Total Volume After Mixing Cu. ft.	Ratio of mix to original volume (%)	% of voids in mix
1	16	50.0	16	50.0	32	25.8	80.6	34.8
2	14	46.7	16	53.3	30	25.0	83.3	36.7
3	12	40.0	18	60.0	30	25.8	86.0	36.7
4	10	35.7	18	64.3	28	25.0	89.3	36.7

materials were then dumped into a square box, 4' 3" x 3' 4" x 2' deep and the volumes and the voids measured, the object being to secure the least voids and therefore approximately the densest mix, that could be obtained by varying the proportions of the two grades of gravel.

The volumes were obtained by leveling down the material in the box with a straight edge, and then measuring down to the top of the material at a number of points, from the lower edge of a straight edge laid across the top of the box. From these measures the volumes could be easily calculated.

The voids were measured by shoveling enough of the mixture into a metal can, of 2.5 cubic feet capacity, to fill it level full, and then pouring in water till the latter also should be level with the top of the can. The amount of water was measured as it was poured in, the measure being a 10-quart circular tin bucket, of uniform diameter to permit easy measuring of fractional quantities.

The results of our such tests are given in Table 1 above.

The figures indicate that the mix containing equal parts of the fine and the coarse gravel contains not only the least ratio of volume of the mix to original volume, but also the least percentage of voids, and it was determined to adopt it as the standard mix for the concrete. Using the large gravel in larger proportions than this was inadvisable owing to the excessive waste of fine gravel., due to the preponderance of the fine over the coarse in the pit, amounting as already indicated, to about 50%. To increase the proportion of coarse gravel in the mix beyond the 16-16 figure would involve such an expense for hauling, washing, screening, and wasting the large excess of small gravel that the loss would more than offset the saving due to economy in cement.

The ratio of the aggregates being thus determined, it remained to test the sand for the mortar. In these, the amount of moisture in the sand proved to be important, and was investigated with considerable care.

In preliminary tests to determine the voids in the sand by dumping in a square box of one cubic foot capacity and pouring in water, it was found that the sand settled, until, in some cases, when fully saturated, its volume was reduced by about 20 per cent. With damp sand, such a phenomenon was of course to be expected. The reduction in volume was found to be dependent also on the quantity of moisture in the sand as it came from the bin, the tests being made with the regular material as it came from the screening plant. When fresh from the screen, the sand was rather wet. Where it lay next the steam pipes which had been introduced to keep it from freezing during the winter concreting, it would become quite dry. In intermediate positions, it would show intermediate percentages of saturation.

The sand was also tested by mixing it with the aggregates as in making concrete, the operation being carried out in the regular concrete mixing plant, as shown in Fig. 105. In these tests, varying quantities of moisture in the sand were found to give varying measures of mortar in the mix, for evident reasons. The damp sand hangs together in irregular masses, cohering by reason of the moisture which coats it, with irregular voids between the

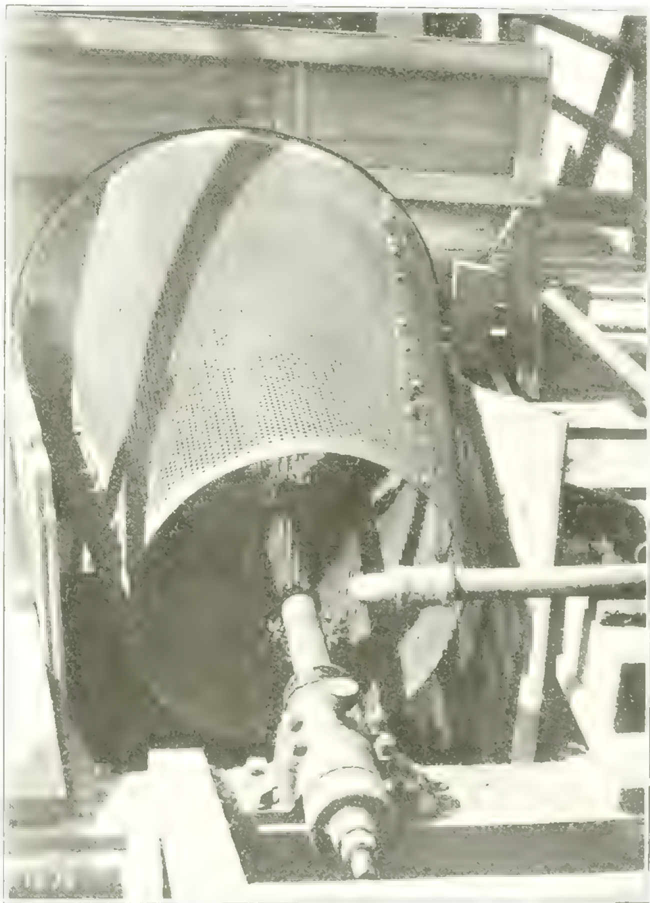

FIG. 106—THE SAND SCREEN.

This is the lower of the screens shown in Fig. 105. It revolves on the inclined shaft shown. The holes are ⅜ inch in size. Pieces smaller than about ¼ inch drop through into the sand bin. Larger pieces slide and roll down the inside slope of the screen and on out of its mouth to the fine gravel bin. The pipe at the right jets water through a nozzle down and into the mouth of the screen, washing the materials and helping also to screen them. Taken March 12, 1919.

Table 2

No. of Test	Coarse Gravel Cu. ft.	Fine Gravel Cu. ft.	Sand Cu. ft.	Volume Mixed Cu. ft.	Remarks
5	16	16	14	34.4	
6	16	16	13	36.7	
7*	16	16	00	25.8	Check on Test No. 1
8	12	18	13	33.6	Sand Damp.
9	16	16	10	32.1	Sand More Damp
10	16	16	13	30.5	Sand Saturated.

masses. Dry sand does not cohere; neither does wet sand, both permitting the grains to take their natural pack. Thus with damp sands, the voids will vary with the degree of dampness, while with dry or wet sands, the voids remain, for a given sand, practically constant. Evidently, then, to get rid of the irregular proportion of mortar, due to the irregular quantity of moisture in the sand, it would be only necessary to saturate the sand with water during the charging into the measuring box.

Table 2, showing tests 5-10 inclusive, exhibits these facts.

Tests 5 and 6 show the effects of varying dampness of sand on the volume of the mix. In both, the same proportions of coarse and fine gravel were used—the adopted standard 16-16 mix. In test 5, 14 cubic feet of sand were added; in test 6, only 13 cubic feet. Yet the latter mix, containing one cubic foot less of the original ingredients, occupied, mixed, 2.3 cubic feet greater volume, due to its greater sponginess of texture, this in turn being due, undoubtedly, to its differing moisture content.

These two tests were made with sand taken at random as it came from the bin to the measuring box. Tests 8-10 show the effect of controlling the moisture, the amount of the latter being not measured but roughly estimated, the sand in No. 8 being called "damp," in number 9, "more damp," and in number 10, "saturated." The last contained all the water it would hold by capillarity. These tests show successively diminishing volumes in the mixed material with the increasing moisture in the sand, indicating thus a closer and closer pack of the mix and a correspondingly lesser and lesser quantity of required cement for the voids. Comparison between Tests 8 and 9 is a trifle obscured by the differing ratios of sand and fine and coarse aggregates, as is also that between Tests 9 and 10; nevertheless, the general relations are quite clear. Between tests 8 and 10 the comparison is decisive, as the shrinking of damp sand when thoroughly wet would lead one to expect.

Constancy of mortar in the mix being thus assured by saturation of the sand, its amount was determined, not by making the sand equal to the voids in the mixed aggregates, with cement equal to voids in the sand, by any theoretical process, but practically, by careful observation of the behavior of the mixed concrete in the mixer and in the forms. With the irregular grading of the sand and of the fine gravel, previously noted, this was especially important.

For the sand, the grading is shown in Table 3, giving the result of a series of analyses with the Universal Sand Tester. This apparatus is equipped with five screens, the mesh, size of wire and size of opening for each being given in the table. The figures in each test show the per cent of the total material passing the various screens.

The figures show the great variability in the grading; also the occurrence in the gravel pit of pockets (as in tests 5-11 inclusive) of "buckshot sand;" i. e., sand showing preponderance of the larger grains. The same pockets are likely to show a corresponding preponderance, in the fine aggregate, of "pea gravel," and in both cases the materials give trouble at once in the mixer and in the forms. The "life" goes out of the mix. In the form it "piles up like a heap of rocks," and is difficult to shovel or tramp into place. In the mixer it sulks and hangs, with corresponding loss of time in getting out the batch.

The reason is the same, whether the excess be of buckshot sand or pea gravel, and may be easiest

Table 3

Screen No.	6	10	20	35	65
Diameter of wire	.036	.035	.0172	.0122	.0072
Size of opening	.131	.065	.0328	.0164	.0082
Test No. 1	90%	78%	63%	22%	2%
Test No. 2	85 "	72 "	66 "	23 "	3 "
Test No. 3	81 "	67 "	56 "	23 "	2 "
Test No. 4	74 "	58 "	34 "	10 "	3 "
Test No. 5	68 "	50 "	31 "	7 "	1 "
Test No. 6	55 "	26 "	14 "	7 "	2 "
Test No. 7	59 "	36 "	20 "	8 "	2 "
Test No. 8	67 "	42 "	21 "	3 "	1 "
Test No. 9	73 "	48 "	27 "	5 "	1 "
Test No. 10	71 "	41 "	15 "	7.5%	1 "
Test No. 11	71 "	40 "	22 "	5%	1 "
Test No. 12	75 "	49 "	33 "	10 "	1 "
Test No. 13	77 "	58 "	28 "	12 "	1 "

* Test 7 was simply a repetition of Test 1 in Table 1, to check the voids in the 16-16 gravel mix. It happened to check precisely.

grasped by taking the latter case, and supposing the fine gravel to be all of pea size. Then the voids in the coarse gravel would still be filled by the pea gravel, since the measured quantities remain the same; but the voids in the pea gravel, being uniform, would be greater than for properly graded fine gravel, for reasons given in the article on Proportioning Concrete in the Bulletin for January, 1919; and the mortar, being adjusted to the properly graded material, would fail to fill the voids in the pea gravel. Thus the mortar, which in working acts as "grease" to the gravel, both in the mixer and in the forms, would fail in that function, with the resulting difficulties noted above.

These troubles are mended, when not too great, by getting rid of the excess of the buckshot sand and pea gravel. The excess buckshot sand is carried over into the gravel bin. This is accomplished by diminishing the force of the jet of water (see Fig. 106), which shoots in at the lower end of the sand screen. This jet drives back the fine gravel as it slides down the slope of the revolving screen, and gives the sand time to find the holes and drop through them into the sand bin. By diminishing the force of the jet, much of the larger sand will fail to find a hole and will thus slide on into the fine gravel bin.

Here it is got rid of, as well as the pea gravel which accompanies it, by so arranging the chute that the materials drop onto a "buck-sand" screen, set up slantwise, just as in ordinary screening by hand. The sand and pea gravel drop through next the outer wall of the bin and are carried into a car on the gravel track by a chute. The coarser sizes slide down the buck-sand screen to the side of the bin next the mixer, whence they are drawn into the measuring box for fine aggregate. The obnoxious materials are wasted.

When the quantity of these materials involves too expensive a waste, the dragline excavator in the gravel pit shifts the digging, and attacks a fresh spot where the material shows a better grading. The beds of bad material usually occur at the lower levels, so that by shifting to a higher stratum, the difficulty can be cured.

Part of the cost of wasting the excess fine gravel is due to the expense of an attendant at the waste chute, and the use of cars and locomotive. It is proposed to get rid of this by reaming out the holes in the lower 12 to 18 inches of the revolving sand screen, to a larger (½") size. The buckshot sand and pea gravel will then be largely drawn off through these holes, and led to the gravity chute which carries the waste water, used in screening, back to the river.

The variable and somewhat unfavorable grading of the fine gravel available makes it necessary to use a somewhat larger proportion of sand in the mix. The voids in the 16-16 mix of aggregate are about 9 cubic feet. With this mix it is necessary to use 13 cubic feet of sand to secure a smooth working concrete, the cement being 4 cubic feet. This makes the mix a 1 : 3.25 : 6.4 concrete. Enough water is added to give the mixture the consistency of a medium stiff porridge. The mix conforms to the well-known practical rule of employing the mortar giving most economically the necessary strength—(which means in practice using the least cement which will give the strength)—and then "feeding" it all the aggregate it will bear and at the same time work without undue difficulty in the forms.

In this connection the saturation of the sand before charging it into the mixer was found decidedly advantageous. It not only insured uniformity in the charge of sand, already referred to, but it aided the speed and smoothness of the mix, permitting the charge to flow easily into the drum of the mixer, and the materials to readily mingle. A measured amount of water was run into the measuring box with each sand charge. Wetting the gravel aggregates by playing a hose on them just before they entered the measuring box, helped the process. The final adjustment of the water in the mix was made by jetting it into the mixer through a nozzle till the desired consistency, judged by eye, was reached. The effect of the preliminary saturation of the sand on the speed of the mix was marked. It also helped the mix by preventing the newly charged materials from hanging and riding up on the rising side of the mixer and spilling out of the hole at the charging end, which if merely damp they would do. In addition to preventing the loss of materials, this increased the size of the batch, and speeded up the process thus in another way. In placing 3,000 cubic yards of concrete, measured in the forms, the 1-yard Smith mixer averaged 1.2 cubic yards to the batch.

Repeated attempts to make use of the excess of the fine aggregate, by running it without admixture of the coarse, after the latter had been used up in the regular combination, proved to be uneconomical, requiring so great an addition of cement to the mix to make the concrete workable in the forms, that the saving in fine aggregate was more than counterbalanced by the cost of the added cement.

The work at Taylorsville is under the general direction of O. N. Floyd, Division Engineer, H. L. Freund, Assistant Division Engineer, and H. M. Sherwood, Superintendent of Construction.

Concreting Plant for Robert Boulevard Wall, Dayton

Plant of Stationary Type. Materials Delivered to Bins and Mixer Through Elevated Hoppers, and to Forms by Concrete Cars on 3-Foot Gage Track.

Between Third and Fifth Streets, in Dayton, the necessities of enlarged capacity and improved alignment of the river led to an unavoidable cutting in upon Robert Boulevard and the adjacent valuable property along the east bank. In order to reduce this to the lowest limits, it was advisable to substitute a concrete wall for the usual earth levee necessary to guard against overflow in flood seasons; thus saving the space occupied by the long land slope of the levee. The wall will extend from the east abutment of the Fifth Street Bridge to the east abutment of the Third Street Bridge, a total distance of 1036.4 feet. (See map, Fig. 107). The total height is 25 feet; the base thickness or width of footing, 14 feet; and the thickness at the top, 12 inches. The wall is being built in 16-foot sections, separated by vertical joints cutting through the entire wall, both neat work and footing, with a layer

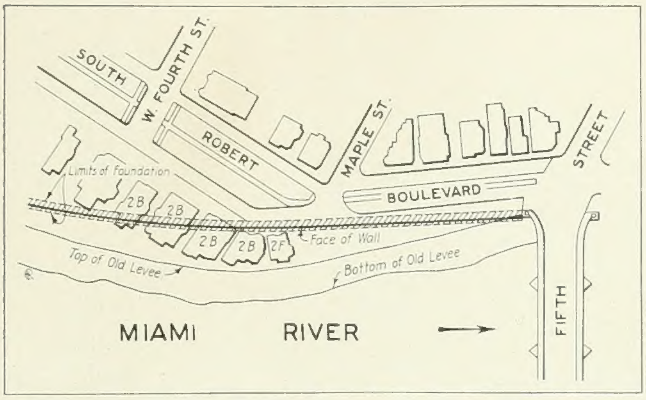

FIG. 107—MAP OF ROBERT BOULEVARD WALL.

of asphalt between the sections. The work will require for completion some 4500 cubic yards of concrete. The design is of the semi-reinforced type, as giving maximum economy of construction, and is shown in Fig. 110, to the caption of which the reader is referred for explanation of the chief features.

To provide the necessary concrete for such a wall the engineers had choice of a mixing plant of either the stationary or the movable type. The latter would follow the wall as it was built, chuting the concrete directly into the forms. The former would chute the concrete into wagons or dump cars, which would haul the mixed material to the place where it would be used. In case of the movable type, the materials to be mixed to make the concrete would have to follow the moving plant, the delivery in this case being by motor trucks. Owing to the inaccessibility of the moving plant in the crowded locality, in certain places, and also to eliminate the handling of the material at the mixer by hand, the stationary type of plant was adopted. It is shown in Fig. 100. The arrangements where the wall is under construction are shown in Fig. 108, the mixed materials being transported to this point from the mixer by dump cars, running on a narrow gage track. This figure gives the plan and elevation of the whole plant as it was at the beginning of the work.

The excavation for the wall is being carried to an average depth of about 20 feet, the bottom width being 14 feet. The excavation is made with one of the timber stiff-leg derricks with 62 foot steel boom (described in the Bulletin for December, 1919, in connection with the Ohio Electric railway grading). It has a 3-drum steam hoisting engine, is equipped with both dragline and clam shell buckets of one-yard capacity, and runs on skids and rollers. Excavation being inexpensive with this machine, little sheet piling is being used to enclose the excavation for the wall, the sides being carried up in earth at about a ½-to-1 slope, making the top width of the opening about 35 feet. In some places, where the trench runs close to buildings, sheet piling will also have to be used.

The general plan of the forms is indicated in Fig. 110. The lower form, for the footing, is not shown, being of the ordinary built-in-place type. The wall forms, as shown, are movable sectional forms, the two faces held apart by spreaders and clamped together by bolts and nuts. They are in 16-foot lengths, corresponding to the sections in the wall, and are swung forward from section to section by Derrick No. 2, which is a twin machine, practically, to Derrick No. 1, already described. These wall forms are divided horizontally into two parts, permitting their adaptation to two slightly different proportions of the wall used in different localities; and permitting also an easier taking down and setting up of the sections, the latter, 16′ by about 20′ in size, being rather bulky without division into pieces.

Derrick No. 2, besides handling the forms, does such backfilling behind the finished wall footing as is necessary to secure the earth under the narrow gage concreting track, the steep slope of the excavation, under thaw, sloughing off somewhat in places. Most of the back fill will be done more cheaply by the big dragline in the course of the

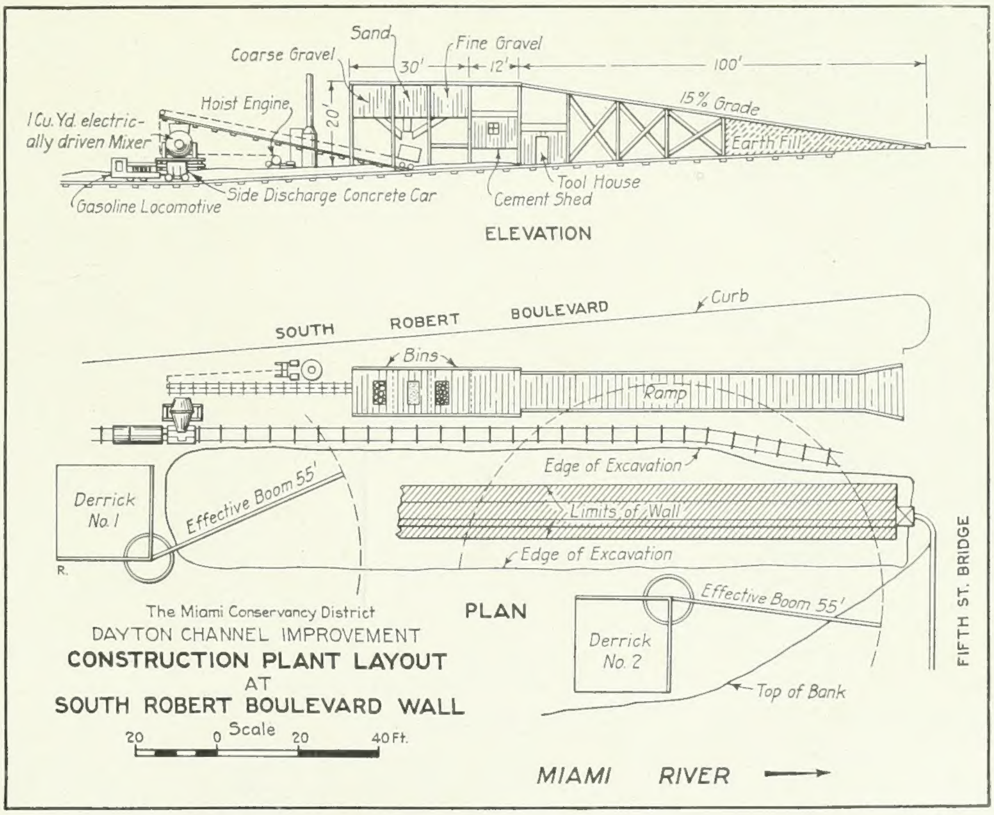

FIG. 108—CONSTRUCTION PLANT LAYOUT AT ROBERT BOULEVARD WALL.

FIG. 109—HOUSES ON ROBERT BOULEVARD, WRECKED TO BUILD WALL.
These are the houses marked "2B" and "2F" in Fig. 107, the first house above being the "2F" house, a frame structure, the others being of brick. They were all built on made ground, part of it levee, and encroached on the natural border of the river, necessitating their removal. The wall in Fig. 100 runs just in front of the first two houses, (as seen here,) and through the sites of the next three. The wall takes the place of a levee, and is used as requiring less space, thus leaving Robert Boulevard as wide as possible. Its top is about on a level with the middle of the upper sash in the first story windows.

regular river channel improvement. Derrick No. 2 also hoists and dumps concrete cars, which in case of the upper forms cannot chute the material directly into place.

The sand and gravel for the concrete are obtained from the bed of the river and are washed, screened and sorted in a plant practically identical with that shown in Fig. 105. From this plant, situated on the river bank at the mouth of Wolf Creek, the prepared materials are hauled in 5-ton motor-dump trucks to the mixing plant at the work, near the east end of the Fifth Street bridge, where they are dumped into hoppers at the top of an incline, leading to bins for the sand and the aggregates. The sand runs from $\frac{1}{4}$ inch down; the fine gravel from $\frac{1}{4}$ to $1\frac{1}{2}$ inch; and the coarse gravel from $1\frac{1}{2}$ inch to 3 inch. The bins hold about 15 cubic yards each.

From the bins the materials are drawn through chutes into a bottom-dump car running on a track built at 15° incline, which leads to a platform over the mixer. Between the chutes and the car, measuring boxes are interposed, which permit the proper proportioning of the material. These proportions are 4 sacks cement to 9.6 cubic feet of sand, to 10 cubic feet each of the fine and the coarse gravel. This gives a 1 : 2.4 : 5 concrete.

The car is hauled up the incline by a single drum hoist engine, and dumps at the top into a hopper

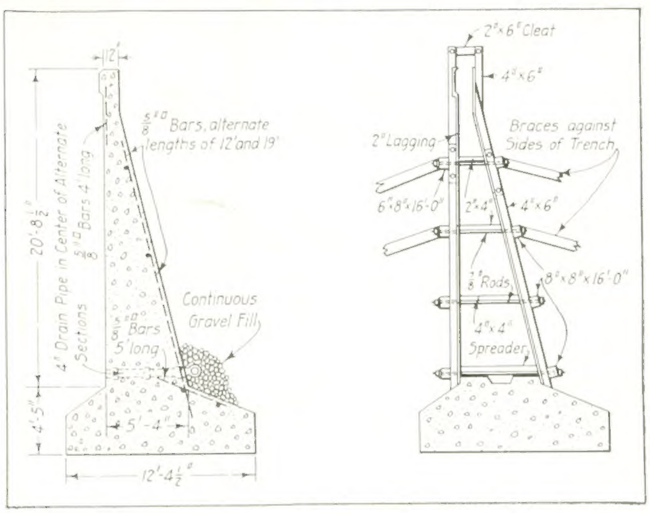

FIG. 110—SECTIONS OF WALL AND FORMS FOR CONCRETE.
The base is 12′ $4\frac{1}{2}$″ wide and the total wall height 25′ $1\frac{1}{2}$″. Base and wall above are built separately, keying with each other as shown at the right. The same mix of concrete is used in both. The design is of the semi-reinforced type, as being most economical.

which holds one complete batch. This hopper is kept filled and ready at all times. From the hopper the batch is drawn into a Smith one-yard mixer, driven by a $7\frac{1}{2}$ H. P. alternating current motor, and given a one-minute mix. From the mixer it is discharged into concrete cars running on a 3-foot gage light railway leading alongside the wall excavation, whence it is discharged into the concrete forms. The cars are drawn by a 3-ton Plymouth gasoline dinkey.

The concrete cars are of two types. One is a side dump car, discharging its materials into the form for the footing through a sloping chute. Materials for the upper part of the wall cannot be thus chuted, the wall top being on a level above that of the concrete track. In this case a bottom dump bucket of special form is used, riding on a small platform car, from which it is lifted by Derrick No. 2 and dumped wherever wanted. Both types are of one cubic yard capacity.

Most of the wall built to date has been poured in freezing weather. To meet this condition, the bins are warmed with steam pipes, two in each compartment, placed just above the bottom discharge gates. The water used in the mix is also heated, in a wooden tank, by means of a steam coil. The boiler supplying steam for these pipes also feeds the hoist engine which pulls the cars of material up the inclined railway to the mixer. The concrete, by the means described, has been placed in the forms at a temperature not below 50 degrees F. in the coldest weather. After being poured it has been protected by covering the entire form with tarpaulin, under which salamanders charged with coke are kept burning. With these precautions, no concrete has been frozen.

The design of this plant is due to Leslie Wiley, Superintendent of Construction on the District's railway work. The Dayton channel work is under the general direction of C. A. Bock, Division Engineer, E. L. Chandler, Assistant Division Engineer, and H. A. Hanson, Superintendent of Construction.